The bioavailability of colloidal P to freshwater algae

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The eutrophication of freshwaters is a major environmental concern in developed countries and is often attributed to excessive P fertilizer application. However, the eutrophication risk depends strongly on P bioavailability, which in turn depends on P speciation. Colloidal P species, *e.g.* P associated with colloidal Fe and Al oxyhydroxides, are included in routine colorimetric measurements of the available P fraction as "molybdate reactive P", but the availability of this colloidal P fraction remains questionable. The aim of this study was to address the bioavailability of colloidal P in a well-defined model system. Growth and P uptake by a freshwater green alga (*Raphidocelis subcapitata*) were measured in synthetic solutions with or without colloidal Fe oxyhydroxides. Short term (1 hour) uptake experiments using radiotracers show that algal P uptake decreases with increasing colloidal P fraction. The P uptake rate is related to the free orthophosphate fraction (quantified by 10 kDa ultrafiltration), *i.e.* colloidal P does not contribute to the actual P uptake. Growth experiments on the longer term (up to 14 days) under P-limited conditions reveal that colloidal P contributes partially, but not completely, to algal growth. This is likely a result of desorption when free orthophosphate is taken up and becomes depleted. This potential P bioavailability correlates to the "labile P pool", which is quantified by dialysis of the test solution against ferrihydrite as infinite P sink. It is concluded that colloidal P is only partially bioavailable, and that the eutrophication risk in freshwaters may be overestimated if P is measured as "molybdate reactive P".